FORM PTO-1390 (REV 5-93)

U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: 127FR/50019

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

JUN 18 2001

U S APPLICATION NO. (if known, see 37 CFR 1 5): 09/868317

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/09969	December 15, 1999	December 17, 1998

TITLE OF INVENTION
Structured Pre-Form Bodies for Sound Absorption

APPLICANT(S) FOR DO/EO/US
Gerhard BABUKE, Philip LEISTNER, Helmut FUCHS, Xueqin ZHA

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C 371

3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U S.C 371(b) and PCT Articles 22 and 39(1).

4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))

   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau)

   b. [X] has been transmitted by the International Bureau

   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US)

6. [X] A translation of the International Application into English (35 U.S C. 371(c)(2)).

7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S C. 371(c)(3))

   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau)

   b [ ] have been transmitted by the International Bureau.

   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.

   d. [X] have not been made and will not be made.

8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S C. 371(c)(3)).

9. [X] An oath or declaration of the inventor(s) (35 U.S C. 371(c)(4)). (UNEXECUTED)

10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Item 11. to 16. below concern other document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. [X] A FIRST preliminary amendment.

    [ ] A SECOND or SUBSEQUENT preliminary amendment

14. [x] A substitute specification

15. [ ] A change of power of attorney and/or address letter

16. [X] Other items or information.
5 Sheets of Drawings showing Figs. 1-10

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/868317	PCT/EP99/09969	127FR/50019

17. [X] The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO ..... $860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... $690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482)	$860.00	
but international search fee paid to USPTO (37 CFR 1.445(a)(2) ..... $710.00 Neither international preliminary examination fee (37 CFR 1.482) nor		
international search fee (37CFR 1.445(a)(2) paid to USPTO ..... $1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482)		
and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$130.00	

Claims	Number Filed	Number Extra	Rate	
Total Claims	11-20=	0	X $18.00	$0.00
Independent Claims	1-3=	0	X $80.00	$0.00
Multiple dependent claims(s) (if applicable)			+ $270.00	$
TOTAL OF ABOVE CALCULATIONS =				$990.00
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$
SUBTOTAL =				$990.00
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	$
TOTAL NATIONAL FEE =				$990.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). $40.00 per property +				$
TOTAL FEE ENCLOSED =				$990.00
			Amount to be: refunded	$
			charged	$

a. [X] A check in the amount of $ 990.00 for the filing fee is enclosed

b. [ ] Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. 05-1323 . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
Crowell & Moring, L.L.P.
P. O. Box 14300
Washington, D.C. 20044-4300
Tel. No. (202) 628-8800
Fax No. (202) 628-8844

for 39035
SIGNATURE
Donald D. Evenson
NAME
Registration No. 26,160
REGISTRATION NUMBER
June 18, 2001
DATE

Attorney Docket: 127FR/50019
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: GERHARD BABUKE ET AL.

Serial No.: Not Yet Assigned

PCT No.: PCT/EP99/09969

Filed: June 18, 2001

Title: STRUCTURED PRE-FORM BODIES FOR SOUND ABSORPTION

PRELIMINARY AMENDMENT

Box PCT
Commissioner for Patents
Washington, D.C. 20231

Sir:

Please enter the following amendments to the specification, claims and abstract prior to the examination of the application.

IN THE SPECIFICATION:

A substitute specification is filed herewith.

IN THE CLAIMS:

Please cancel all of the claims presently in the application and substitute new Claims 11-20 as follows:

11. (New) Structured pre-form bodies as panel lining for wide-band sound absorption, comprising:

a base layer;

a columnar structure positioned directly in front of or on the base layer and having a non-symmetrical distribution of height and cross-section, thereby forming a wide-band tuned moderator gap,

wherein the columnar height corresponds approximately to the density of said base,

wherein the columnar structure has a framework resonance adjustable as a function of parameters of the base layer, and

wherein the structured pre-form bodies comprise open-cell foam material having a rigid framework co-vibrating in a resonant manner at low frequencies.

12. (New) Structured pre-form bodies according to Claim 11, wherein at least part of said open-cell foam material comprises a melamine resin.

13. (New) Structured pre-form bodies according to the Claim 11, wherein said columnar structure has one-side bevel cuts on a room side and wherein said moderator gap is a one-side bevel cut on the base.

14. (New) Structured pre-form bodies according to Claim 13, wherein said bevel cuts on the room side are configured to alternate in at least one of a vertical or a horizontal direction.

15. (New) Structured pre-form bodies according to Claim 13, wherein said bevel cuts on the room side are shortened and flattened by up to 30 mm.

16. (New) Structured pre-form bodies according to Claim 13, wherein said bevel cuts on the room side have an angle of roughly 35° relative to the plane of the wall.

17. (New) Structured pre-form bodies according to Claim 11, further comprising acoustically transmissive covers made

of non-woven or woven material or soft cellular material supported on a plane of said bevel cuts on the room side.

18. (New) Structured pre-form bodies according to Claim 11, further comprising perforated panels in front of said pre-form bodies for mechanical protection, which are fastened to a wall by spacers.

19. (New) Structured pre-form bodies according to Claim 11, wherein said pre-form bodies are self-supporting due to at least one of their material or shape.

20. (New) Structured pre-form bodies according to Claim 11, wherein said base layer is fastened on a rear side to vibrating metal sheets of a composite panel resonator by an adhesive bond, with a lateral spacing of roughly 200 mm being provided between said vibrating metal sheets.

21. (New) A panel lining comprising the structured pre-form bodies according to Claim 11.

IN THE ABSTRACT:

Please substitute the new Abstract of the Disclosure submitted herewith on a separate page for the original Abstract.

REMARKS

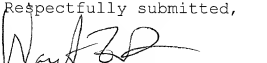
Claims 11-21 are pending herein. By this Amendment, Claims 1-10 are canceled, and new Claims 11-21 are added. Entry of the amendments to the specification, claims and abstract before examination of the application is respectfully requested.

If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #127FR/50019).

June 18, 2001

Respectfully submitted,



Donald D. Evenson
Registration No. 26,160

Warren A. Zitlau
Registration No. 39,085

DDE:WAZ:vca
CROWELL & MORING, LLP
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 628-8800
Facsimile No.: (202) 628-8844

ABSTRACT OF THE DISCLOSURE

Structured pre-form bodies as panel lining for wide-band sound absorption are made of an open-cell foam material having a rigid framework co-vibrating in a resonant manner at low frequencies. The pre-form bodies have a base layer and a columnar structure positioned directly in front of or on the base layer. The columnar structure has a non-symmetrical distribution of height and cross-section, thereby forming a wide-band tuned moderator gap and the columnar height corresponds approximately to the density of the base layer. The columnar structure has a framework resonance adjustable as a function of parameters of the base layer.

Attorney Docket: 127FR/50019
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: GERHARD BABUKE ET AL.

Serial No.: Not Yet Assigned PCT No.: PCT/EP99/09969

Filed: June 18, 2001

Title: STRUCTURED PRE-FORM BODIES FOR SOUND

SUBMISSION OF SUBSTITUTE SPECIFICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Attached is a Substitute Specification and a marked-up copy of the original specification. I certify that said substitute specification contains no new matter and includes the changes indicated in the marked-up copy of the original specification.

Respectfully submitted,

June 18, 2001

Warren A. Zitlau
Registration No. 39,085

Donald D. Evenson
Registration No. 26,160

DDE:WAZ:vca
CROWELL & MORING, LLP
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 628-8800
Facsimile No.: (202) 628-8844

STRUCTURED PRE-FORM BODIES FOR SOUND ABSORPTION

BACKGROUND AND SUMMARY OF INVENTION

[0001] The present invention relates to structure pre-form bodies consisting of open-cell foamed material presenting a comparatively solid framework co-vibrating in a resonant manner at low frequencies as panel lining for wide-band sound absorption.

[0002] Structured sound-absorbing panel linings are known for the application in acoustic free-field spaces, which consist of a porous material and present substantially a wedge-shaped or pyramidal geometry [1, 2, 3, 4]. This outside geometry is realized with both compact shaped or pre-formed bodies [1, 2, 3] and also with layers or other element assemblies [4].

[0003] The acoustic classification [1] of these panel linings is mainly determined by a frequency-independent high degree of absorption at an orthogonal incidence of sound. The lower critical or limit frequency, from which onwards this high absorption level is reached, is of particular importance because it is decisive for the total thickness of the panel lining. Conventionally structured linings are governed by the relationship that the lining thickness corresponds roughly to one quarter of the wavelength of the lower limit frequency when a 99% degree of absorption is required. This furnishes a lining thickness of roughly 0.85 meters at a lower limit frequency of 100 Hz. In view of this magnitude it becomes evident that a reduction of the lining by roughly 40% saves not only some volume of the structure but also enlarges the measuring radius in the space [5] with an unvaried high degree of absorption.

[0004] The present invention is based on the problem of designing the pre-form bodies according to prior art in a way that the structural depth may be made smaller while the acoustic characteristics are retained at a constant level.

[0005] This problem is solved by the pre-form bodies according to the present invention.

[0006] The pre-form bodies consist of a plane base layer of a defined thickness on the side of the wall as well as a columnar structure positioned directly in front of the base layer and having a defined distribution of height and cross-section in the manner of a wide-band tuned moderator gap. The maximum columnar height corresponds expediently to the thickness of the base and the columns have a one-side bevel cut on a room side whilst the moderator gap has a one-side bevel cut on its base side.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1: structure of the inventive pre-form bodies consisting of the base layer (1) and the column array (2) with an bevel cut (3) on the room side;

[0008] Fig. 2: exemplary combination of the inventive pre-form bodies to form a large-side panel lining;

[0009] Fig. 3: structure of the inventive pre-form bodies with the angle w of the one-side bevel cut (3);

[0010] Fig. 4: combination of the inventive pre-form bodies with a composite panel resonator (4);

[0011] Fig. 5: structure of the inventive pre-form bodies with the flattening (5) on the room side of the array of columns (2) presenting a one-side bevel cut;

[0012] Fig. 6: structure of the inventive pre-form bodies with the protective cover (6) on the room side;

[0013] Fig. 7: exemplary inventive pre-form bodies (total thickness 520 mm);

[0014] Fig. 8: exemplary conventional panel lining consisting of mineral-wool panels (total thickness 650 mm);

[0015] Fig. 9: contrastive comparison of the measured degrees of absorption for an orthogonal sound incidence of the inventive pre-form bodies according to Fig. 7 against a conventional panel lining according to Fig. 8; and

[0016] Fig. 10: illustration of the waste-free cutting of the inventive pre-form bodies.

DETAILED DESCRIPTION OF THE DRAWINGS

[0017] The pre-form bodies according to the present invention consist of an open-cell foamed material presenting a comparatively solid framework co-vibrating in a resonant manner at low frequencies, such as the cellular melamine resin known by the trademark BASOTECT®. The sound absorption by this material is defined, on the one hand, by its porosity, i.e., by the conversion of sound energy into thermal energy due to friction. On the other hand, the comparatively rigid framework surrounding the open cells creates the effect of an acoustic mass whose movement or deformation, respectively, represents a further resonance-like mechanism of absorption. This resonance distinctly increases the absorption at low frequencies, with the resonance frequency being shifted farther towards low frequencies as the thickness of the layer increases.

[0018] The starting point of the inventive pre-form bodies is therefore a plane base layer (1) having the thickness H1 (between 200 and 500 mm, preferably 250 mm) and made of such a cellular material as is illustrated in Fig. 1, which, in distinction from layers of foamed material producing negligible framework vibrations at low frequencies and having a degree of absorption of almost 1. A BASOTECT® panel, 150 mm thick, may be mentioned as an example, which absorbs already 99% of the orthogonally incident sounds energy at roughly 125 Hz (Fig. 9).

[0019] In the range of medium and high frequencies, the sound absorption is due to the sound impedance in combination with the thickness of the cellular material. Depending on the thickness of the layer, however, a range of up to 15% reduction in sound absorption occurs between these two high-absorption frequency ranges. To balance this reduction a tuned array of columns (2) of cellular material in front of the base layer (1) is joined in the inventive pre-form bodies. At a defined length H2 (in the order of H1) and with square cross-sectional areas (D1, D2, B1, B2 according to Fig. 1 between 50 and 200 mm so that D1+D2 and B1+B2 produce preferably 250 mm), these columns define square hollow chambers in the manner of moderator gaps (Fig. 2) which terminate, on one side, at the base layer (1) and open into the space on the other side.

[0020] The dimensioning of this moderator gap is oriented by the frequency range within which the base layer (1) alone presents an insufficient sound absorption characteristic. Essential design parameters for the moderator gap are its length and the thickness of the lateral attenuation layer. In the exemplary BASOTECT® panel, 250 mm thick, a column height of roughly 250 mm and a column cross-section of approximately 125 mm x 125 mm has been found to be

a suitable column geometry. The further optimization of the inventive pre-form bodies encompasses, *expressis verbis*, different or varying cross-sections of the columns and hence a non-symmetrical design of the moderator gap. The columns of cellular material present a one-side bevel cut (3) at the room-side end so as to avoid an abrupt impedance transition on the surface of the lining. The cutting angle (w) according to Fig. 3 amounts to roughly 35°, relative to the plane of the wall. For the same reason, the moderator gaps terminate on the base side equally in the afore-described cut, rather than in a plane form.

[0021] An embodiment of the inventive pre-form bodies consists in their combination with a composite panel resonator (4)[6] which is employed also in plane sound-absorbing panel linings [7] for extending the frequency range of high sound absorption towards the low frequencies. In the case of a combination with the inventive pre-form bodies, the base layer (1) is connected to the vibrating metal sheet of the composite panel resonator (Fig. 4) on its rear side, e.g., by means of adhesive bonding. Further practical embodiments of the inventive pre-form bodies are acoustically transmissive covers (6) made of non-woven or woven material or perforated panel material for mechanical protection of the lining (Fig. 5). The acoustically almost inefficient flattening (5) by up to 30 mm on the bevel cuts (3) on the room side, which is illustrated in Fig. 6, is provided to this end in order to ensure a partially plane support of large-side cages made of perforated panels.

[0022] The advantages of the inventive pre-form bodies over existing structured panel linings for sound absorption relate to the following features:

- For a specified lower limit frequency, from which onwards a degree of sounds absorption as high as possible must be achieved, a distinctly smaller structural depth (roughly 40%) is sufficient for the inventive pre-form bodies.

- As a result of the rigid framework of cellular material, of the concurrent low weight of unit volume (10 kg/m^2) and the small structural depth (of roughly 500 mm), the inventive pre-form bodies are inherently stable or self-supporting and do not require any holding structure. An adhesive bond on the rear side for attachment to the wall of the room is sufficient for fastening, for instance.

- The acoustically almost inefficient flattening (5) of the bevel cuts on the room side assists the use of covers (6), e.g., with perforated panels, so that a plane lining surface is created that is protected on the side of the room.

- Anti-trickle protection, as it is required, for instance, for panel linings consisting of a fibrous material, is not required.

- There are numerous possibilities of optimizing the production of the inventive pre-form bodies because the fibre-free material is, on the one hand, suitable for prefabrication with optional dimensions and, on the other hand, easy to mount.

- The inventive pre-form bodies are cut from the typical blanks (blocks of cellular material with a size of 1.25 m x 1 m x 2.5 m or panels with an area of 1.25 m x 1 m) in a way that cuttings or waste will not be products, as is illustrated in Fig. 10.

[0023] An exemplary comparison of the inventive pre-form bodies (Fig. 7) against conventional structured wall absorbers (Fig. 8) renders the savings in structural depth with a simultaneously increased measured sound absorption (Fig. 9) even more evident, particularly at low frequencies.

Literature

[1] DIN Standard 45635, Part 1, Annex B 1.2

[2] N.N.: "Reflexionsarme Schallmessräume für Forschung" *[Low-reflection sound-measuring spaces for application sin industry and research]* (company pamphlet), G + H Montage GmbH, 1992

[3] U.S. Patent No. 5,780,785, Acoustic absorption device and an assembly of such device

[4] Rother, P.; Nutsch, Jr. "Prinzip und Andwendung einer neuartigen Wandverkleidung für reflexionsarme Räume" *[Principle and application of a novel panel lining for low-reflection spaces]*, 4th Intern. Congress on Acoustics (ICA), Copenhagen 1962, page M44.

[5] Babuke, G.; Fuchs, H.V.; Teige, K.; Pfeiffer, G.: "Kompakte reflexionsarme Auskleidung für kleine Messräume" *[Compact low-reflection lining for small measuring spaces]*, in: Bauphysik 20 (1998), No. 5, pages 157-165.

[6] German Patent No. DE 19506511, Composite panel resonator

[7] German Patent DE 19738757, Low-reflection room lining for the entire audible range.

PCT/EP99/09969
09/868317
JC03 Rec'd PCT/PTO 18 JUN 2001

Structured Pre-Form Bodies for Sound Absorption

1. Subject matter of the invention

The present invention relates to structured pre-form bodies in correspondence with the introductory clause of Claim 1, consisting of open-cell foamed material presenting a comparatively solid carcass co-vibrating in a resonant manner at low frequencies as panel lining for wide-band sound absorption.

2. Prior Art

Structured sound-absorbing panel linings are known for the application in acoustic free-field spaces, which consist of a porous material and present substantially a wed-shaped or pyramidal geometry [1, 2, 3, 4]. This outside geometry is realised with both compact shaped or pre-form bodies [1, 2, 3] and also with layers or other element assemblies [4]. The acoustic classification [I] of these panel linings is mainly oriented by a frequency-independent high degree of absorption at an orthogonal incidence of sound. The lower critical or limit frequency, from which onwards this high absorption level is reached, is of particular importance because it is decisive for the total thickness of the panel lining. Conventionally structured linings are governed by the relationship that the lining thickness corresponds roughly to one quarter of the wavelength of the lower limit frequency when a 99 % degree of absorption is required. This furnishes a lining thickness of roughly 0.85 metres at a lower limit frequency of 100 Hz. In view of this magnitude it becomes evident that a reduction of the lining by roughly 40 % saves not only some volume of the structure but also enlarges the measuring radius in the space [5] with an unvaried high degree of absorption.

The present invention is now based on the problem of designing the pre-form bodies according to prior art in a way that the structural depth may be made smaller while the acoustic characteristics are retained at a constant level.

In accordance with the present invention, this problem is solved by Claim 1. Expedient embodiments are characterised in the dependent Claims.

The pre-form bodies consist of a plain base layer of a defined thickness on the side of the wall as well as a columnar structure positioned directly in front of the base layer and having a defined distribution of height and cross-section in the manner of a wide-band tuned moderator gap, wherein the maximum columnar height corresponds expediently to the thickness of the base and the columns present a one-side bevel cut on its room side whilst the moderator gap presents a one-side bevel cut on its base side.

3. Description

The pre-form bodies according to the invention consist of an open-cell foamed material presenting a comparatively solid carcass co-vibrating in a resonant manner at low frequencies, such as the cellular melamine resin known by the trade mark Basotect®. The sound absorption by this material is defined, on the one hand, by its porosity, i.e. by the conversion of sounds energy into thermal energy due to friction. On the other hand, the comparatively rigid carcass surrounding the open cells creates the effect of an acoustic mass whose movement or deformation, respectively, represents a further resonance-like mechanism of absorption. This resonance distinctly increases the absorption at low frequencies, with the resonance frequency being shifter the farther towards low frequencies as the thickness of the layer increases. The starting point of the inventive pre-form bodies is therefore a plain base layer (1) having the thickness H1 (between 200 and 500 mm, preferably 250 mm) and made of such a cellular material as is illustrated in Fig. 1, which, in distinction from layers of foamed material producing negligible carcass vibrations at low frequencies and having a degree of absorption of almost 1. A Basotect® panel, 250 mm thick, may be mentioned as an example, which absorbs already 99 % of the orthogonally incident sounds energy at roughly 125 Hz (Fig. 9).

In the range of medium and high frequencies the sound absorption is due to the sound impedance in combination with the thickness of the cellular material. Depending on the thickness of the layer, however, a range of up to 15 % reduction in sound absorption occurs between these two high-absorption frequency ranges. To balance this reduction a tuned array of columns (2) of cellular material in front of the base layer (1) is joined in the inventive pre-form bodies. At a defined length H2 (in the order of H1) and with square

cross-sectional areas (D1, D2, B1, B2 according to Fig. 1 between 50 and 200 mm so that D1+D2 and B1+B2 produce preferably 250 mm), these columns define square hollow chambers in the manner of moderator gaps (Fig. 2) which terminate, on one side, at the base layer (1) and open into the space on the other side. The dimensioning of this moderator gap is oriented by the frequency range within which the base layer (1) alone presents an insufficient sound absorption characteristic. Essential design parameters for the moderator gap are its length and the thickness of the lateral attenuation layer. In the exemplary Basotect® panel, 250 mm thick, a column height of roughly 250 mm and a column cross-section of approximately 125 mm x 125 mm has been found to be a suitable column geometry. The further optimisation of the inventive pre-form bodies encompasses, *expressis verbis*, different or varying cross-sections of the columns and hence a non-symmetrical design of the moderator gap. The columns of cellular material present a one-side bevel cut (3) at the room-side end so as to avoid an abrupt impedance transition on the surface of the lining. The cutting angle (w) according to Fig. 3 amounts to roughly 35', relative to the plane of the wall. For the same reason, the moderator gaps terminate on the base side equally in the afore-described cut, rather than in a plain form.

An expedient embodiment of the inventive pre-form bodies consists in their combination with a composite panel resonator (4) [6] which is employed also in plain sound-absorbing panel linings [7] for extending the frequency range of high sound absorption towards the low frequencies. In the case of a combination with the inventive pre-form bodies, the base layer (1) is connected to the vibrating metal sheet of the composite panel resonator (Fig. 4) on its rear side, e.g. by means of adhesive bonding. Further practical embodiments of the inventive pre-form bodies are acoustically transmissive covers (6) made of non-woven or woven material or perforated panel material for mechanical protection of the lining (Fig. 5). The acoustically almost inefficient flattening (5) by up to 30 mm on the bevel cuts (3) on the room side, which is illustrated in Fig. 6, is provided to this end in order to ensure a partially plane support of large-size cages made of perforated panels.

3. Advantages of the invention over Prior Art

The advantages of the inventive pre-form bodies over existing structured panel linings for sound absorption relate to the following features:

- For a specified lower limit frequency, from which onwards a degree of sounds absorption as high as possible must be achieved, a distinctly smaller structural depth (roughly 40%) is sufficient for the inventive pre-form bodies.

- As a result of the rigid carcass of cellular material, of the concurrent low weight of unit volume (10 kg/m²) and the small structural depth (of roughly 500 mm), the inventive pre-form bodies are inherently stable or self-supporting and do not require any holding structure. An adhesive bond on the rear side for attachment to the wall of the room is sufficient for fastening, for instance.

- The acoustically almost inefficient flattening (5) of the bevel cuts on the room side assists the use of covers (6), e.g. with perforated panels, so that a plain lining surface is created that is protected on the side of the room.

- Anti-trickle protection, as it is required, for instance, for panel linings consisting of a fibrous material, is not required.

- There are numerous possibilities of optimising the production of the inventive pre-form bodies because the fibre-free material is, on the one hand, suitable for prefabrication with optional dimensions and, on the other hand, easy to mount.

- The inventive pre-form bodies are cut from the typical blanks (blocks of cellular material with a size of 1.25 m x 1 m x 2.5 m or panels with an area of 1.25 m x 1 m) in a way that cuttings or waste will not be produced, as is illustrated in Fig. 10.

An exemplary comparison of the inventive pre-form bodies (Fig. 7) against conventional structured wall absorbers (Fig. 8) renders the savings in structural depth with a simultaneously increased measured sound absorption (Fig. 9) even more evident, particularly at low frequencies.

5. Description of the Drawings

Fig. 1: structure of the inventive pre-form bodies consisting of the base layer (1) and the column array (2) with an bevel cut (3) on the room side;

Fig. 2: exemplary combination of the inventive pre-form bodies to form a large-size panel lining;

Fig. 3: structure of the inventive pre-form bodies with the angle w of the one-side bevel cut (3);

Fig. 4: combination of the inventive pre-form bodies with a composite panel resonator (4);

Fig. 5: structure of the inventive pre-form bodies with the flattening (5) on the room side of the array of columns (2) presenting a one-side bevel cut;

Fig. 6: structure of the inventive pre-form bodies with the protective cover (6) on the room side;

Fig. 7: exemplary inventive pre-form bodies (total thickness 520 mm);

Fig. 8: exemplary conventional panel lining consisting of mineral-wool panels (total thickness 650 mm);

Fig. 9: contrastive comparison of the measured degrees of absorption for an orthogonal sound incidence of the inventive pre-form bodies according to Fig. 7 against a conventional panel lining according to Fig. 8;

Fig. 10: illustration of the waste-free cutting of the inventive pre-form bodies.

7. Literature

[1] DIN Standard 45635, Part 1, Annex B 1.2

[2] N.N.: "Reflexionsarme Schallmessräume für Industrie und Forschung" *[Low-reflection sound-measuring spaces for applications in industry and research]* (company pamphlet), G+H Montage GmbH, 1992

[3] US Patent 5780785, Acoustic absorption device and an assembly of such device

[4] Rother, P.; Nutsch, J._ "Prinzip und Anwendung einer neuartigen Wandverkleidung für reflexionsarme Räume" *[Principle and application of a novel panel lining for low-reflection spaces]*, 4th Intern. Congress on Acoustics (ICA), Copenhagen 1962, page M44.

[5] Babuke, G.; Fuchs, H.V.; Teige, K.; Pfeiffer, G.: "Kompakte reflexionsarme Auskleidung für kleine Messräume" *[Compact low-reflection lining for small measuring spaces]*, in: Bauphysik 20 (1998), No. 5, pp. 157 - 165

[6] German Patent DE 19506511, Composite panel resonator

[7] German Patent DE 19738757, Low-reflection room lining for the entire audible range.

Patent Claims

1. Structured pre-form bodies as panel lining for wide-band sound absorption, consisting of open-cell foamed material having a rigid carcass co-vibrating in a resonant manner at low frequencies, **characterised in** that a columnar structure is positioned directly in front of or on a plain base layer (1) on the wall side, that presents a carcass resonance adjustable as a function of the parameters of the layer, which columnar structure has a non-symmetrical distribution of height and cross-section in the manner of a wide-band tuned moderator gap, wherein the columnar height corresponds approximately to the density of said base.

2. Structured pre-form bodies as wall lining for wide-band sound absorption according to Claim 1, **characterised in** that said pre-form bodies consist of a melamine resin foam or are partly made of melamine resin form.

3. Structured pre-form bodies as wall lining for wide-band sound absorption according to the Claims 1 to 2, **characterised in** that said columns (2) present a one-side bevel cut (3) on the room side and said moderator gap presents a one-side bevel cut on the base side.

4. Structured pre-form bodies as wall lining for wide-band sound absorption according to Claim 3, **characterised in** that the orientation of said bevel cuts (3) alternates in the vertical and/or horizontal direction.

5. Structured pre-form bodies as wall lining for wide-band sound absorption according to the Claims 3 or 4, **characterised in** that said bevel cuts (3) on the room side are shortened and flattened, e.g. by up to 30 mm.

6. Structured pre-form bodies as wall lining for wide-band sound absorption according to any of the Claims 1 to 5, **characterised in** that said bevel cut (3) is provided at an angle of roughly 35° relative to the plane of the wall.

7. Structured pre-form bodies as wall lining for wide-band sound absorption according to any of the Claims 1 to 6, **characterised** in that said cuts (3) present a partially plane support of acoustically transmissive plain covers (6) made of non-woven or woven material or soft cellular material.

8. Structured pre-form bodies as wall lining for wide-band sound absorption according to any of the Claims 1 to 7, **characterised in** that perforated panels are provided in front of said lining for the mechanical protection of the lining, which are fastened to the wall of the room by means of spacers.

9. Structured pre-form bodies as wall lining for wide-band sound absorption according to any of the Claims 1 to 8, **characterised in** that said pre-form bodies are designed to be self-supporting by the selection of their material and/or their shape.

10. Structured pre-form bodies as wall lining for wide-band sound absorption according to any of the Claims 1 to 9, **characterised** in that said base layer (1) is fastened on the vibrating metal sheets of composite panel resonators (4) on their rear side by means of an adhesive bond, with a lateral spacing of roughly 200 mm being provided between said vibrating metal sheets.

Abstract of the disclosure

The present invention relates to structured pre-form bodies as panel lining for wide-band sound absorption, which consist of open-cell foamed material having a rigid carcass co-vibrating in a resonant manner at low frequencies, and which are characterised by the provision that a columnar structure is positioned in front of or on a plain base layer (1) on the wall side, that presents a carcass resonance adjustable as a function of the parameters of the layer, which columnar structure has a non-symmetrical distribution of height and cross-section in the manner of a wide-band tuned moderator gap, wherein the columnar height corresponds approximately to the density of said base.

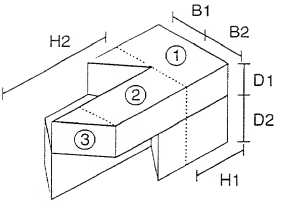


Fig. 1

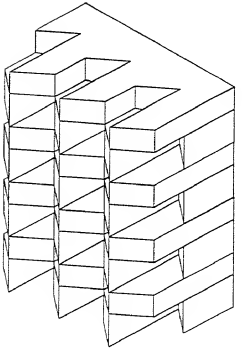


Fig. 2

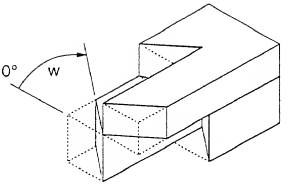


Fig. 3

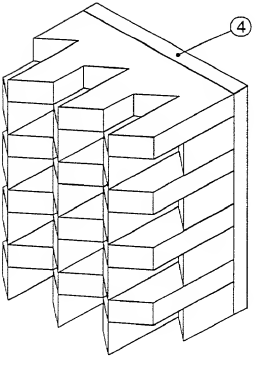


Fig. 4

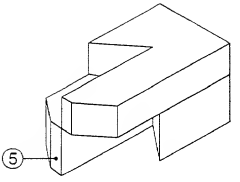


Fig. 5

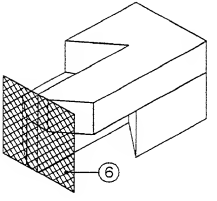


Fig. 6

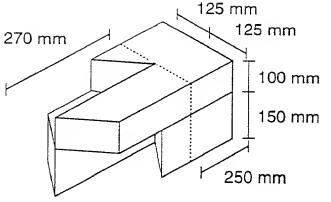

125 mm
125 mm
270 mm
100 mm
150 mm
250 mm

Fig. 7

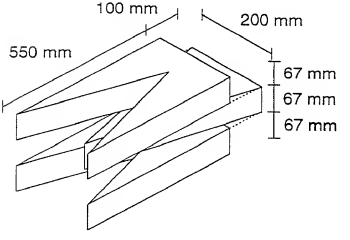

100 mm
200 mm
550 mm
67 mm
67 mm
67 mm

Fig. 8

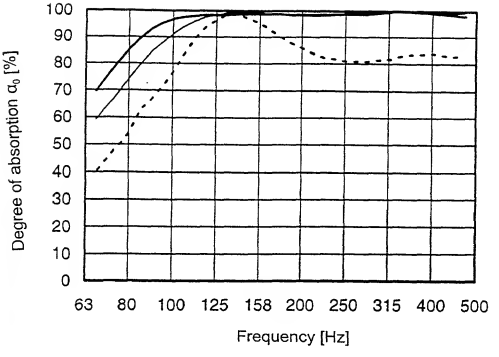

100
90
80
70
60
50
40
30
20
10
0
Degree of absorption α_0 [%]
63
80
100
125
158
200
250
315
400
500
Frequency [Hz]
inventive pre-form bodies according to Fig. 7
conventional panel lining according to Fig. 8
base layer (1), 250 mm thick

Fig. 9

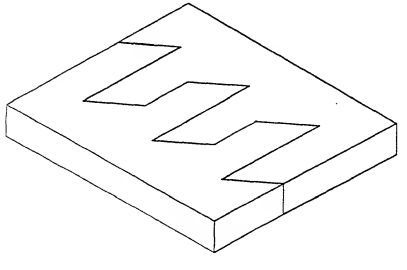


Fig. 10

Attorney Docket No. 127FR/50019

DECLARATION AND POWER OF ATTORNEY - PATENT APPLICATION

As a below named inventor, I hereby declare that my citizenship, postal address and residence are as stated below; that I verily believe I am the original, first and sole inventor (if only one inventor is named below) or a joint inventor (if plural inventors are named below) of the invention entitled:

STRUCTURED PRE-FORM BODIES FOR SOUND ABSORPTION

the specification of which

_____ is attached hereto, or

X was filed as Application Serial No. PCT/EP99/09969 on December 15, 1999

_____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to be material to patentability as defined in 37 CFR §1.56. I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
198 61 016.5	Germany	17 December 1998	yes
(Number)	(Country)	(Day/Month/Year)	

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known to be material to patentability as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status)

I hereby appoint as principal attorneys Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; and Jeffrey D. Sanok, Reg. No. 32,169, to prosecute and transact all business in the Patent and Trademark Office connected with this application and any related United States and international applications. Please direct all communications to:

Crowell & Moring, L.L.P.
P.O. Box 14300
Washington, D.C. 20044-4300
Telephone: (202) 628-8800
Facsimile: (202) 628-8844

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

INVENTOR: Gerhard BABUKE

Citizenship: German

Post Office Address/ Residence: Neuffenstr. 11
71263 Weil der Stadt, GERMANY DEK

July 24, 2001
(date)

Gerhard Babuke
(Signature of 1st inventor)

DECLARATION AND POWER OF ATTORNEY Attorney Docket No. 127FR/50019

INVENTOR: **Philip LEISTNER**
Citizenship: German
Post Office Address/ Residence: Neubauerweg 10
70569 Stuttgart, GERMANY DEX

July 24, 2001
(date)

(signature of 2nd inventor)

INVENTOR: **Helmut FUCHS**
Citizenship: German
Post Office Address/ Residence: Muehlweg 39
71093 Weil, GERMANY DEX

July 23, 2001
(date)

(signature of 3rd inventor)

INVENTOR: **Xuegin ZHA**
Citizenship: Chinese
Post Office Address/ Residence: Waldenbucherstr. 26
71032 Boeblingen, GERMANY DEX

July 23, 2001
(date)

(signature of 4th inventor)